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(19)

(54) METHOD AND APPARATUS FOR THE METALIZATION OF THERMOPLASTIC MATERIALS

(71) We, SWISH PRODUCTS LIMITED of Lichfield Road Industrial Trading Estate, Tamworth, in the County of Stafford, a British Company do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The present application relates to methods and apparatus for the application of metal foil to thermoplastic materials, especially thermoplastic materials in strip or sheet form.

It is known to apply metal foil to thermoplastic materials, for decorative effects or to render the surface of the material electrically conductive, by heating and pressing the foil and thermoplastic materials together. However, the bond formed between the foil and the thermoplastic material, even when the latter is backed with an adhesive, is frequently unsatisfactory and there is a tendency for the foil to delaminate especially when the plastic material is re-heated, e.g. to increase its ductility before a shaping operation. The poor adhesion between the foil and thermoplastic material is particularly evident when the surface of the thermoplastic material onto which the foil has to be adhered is not flat.

We have found that the surface of a polyvinyl chloride may conveniently be coated with a metal foil by applying the foil to the thermoplastic material immediately after the latter has been extruded. Preferably the metal foil is tensioned before being applied to the polyvinyl chloride. The pressure applied to the foil to ensure an adequate bond between the foil and the polyvinyl chloride may be in the order of 100 lbs. per square inch gauge. The coating should take place before any significant degree of quenching of the polyvinyl chloride can take place. In order to improve the adhesion between the foil and polyvinyl chloride, the former may have an adhesive backing.

Accordingly, therefore, the present invention provides a method of applying a metal foil to the surface of polyvinyl chloride sheet or strip material comprising extruding polyvinyl chloride through a die into sheet or strip form having a thickness of at least 0.05 mm, immediately applying metal foil directly thereto under pressure at ambient temperature and while the polyvinyl chloride is in a plastic condition and subsequently quenching the foil-polyvinyl chloride laminate.

The method is especially suitable for applying foil to polyvinyl chloride having shaped, for example, a fluted surface.

The pressure is conveniently applied by means of two rollers at least one of which is driven. When the polyvinyl chloride is extruded in shaped form the roller, or rollers, should be shaped to conform exactly with the surface of the polyvinyl chloride with which they are in contact.

If desired, the foil coated polyvinyl chloride may be subjected to a further shaping operation without undue risk of delamination between the foil and the polyvinyl chloride occurring.

The process described above is particularly suited for the application of aluminium foil to unplasticized polyvinyl chloride strip having a shaped, for example fluted, upper surface. The bond formed between the aluminium foil and the polyvinyl chloride is sufficiently strong to avoid delamination when the polyvinyl chloride is heated to a temperature at which it can be worked.

The present invention also includes apparatus when used in carrying out the above defined process comprising a die through which the polyvinyl chloride is extruded: a pair of nip rolls, one of which is a driven roll, adjacent said die and aligned to receive the extruded strip: means for supplying metal foil to the said nip rolls and including brake means co-operating therewith to apply tension to the metal foil prior to it reaching the said nip rolls: a guide bar to direct the foil between the said nip rolls and means for quenching the extruded and laminated polyvinyl chloride sheet.

The present invention further includes apparatus when used in carrying out the above defined process comprising a die through which the polyvinyl chloride is extruded; a first pair of nip rolls, one of which is a driven roll, adjacent said die and aligned to receive the extruded strip; means for supplying metal foil to the said first nip rolls; a second pair of nip rolls, each of which is freely rotatable, located between the foil supplying means and the first nip rolls to control the rate of withdrawal of the foil from the supply thereof, one of said nip rolls being adjustable to vary the pressure therebetween; a guide bar to direct the foil between the said nip rolls and means for quenching the extruded and laminated polyvinyl chloride sheet.

The method and apparatus of the present invention will now be more clearly illustrated by reference to the accompanying drawings:—

Figure 1 is a diagrammatic illustration of one design of apparatus used in the present invention,

Figure 2 is a diagrammatic representation of the process carried out using Figure 1 together with means for further shaping the foil coated product,

Figure 3 is a diagrammatic representation of an apparatus for applying tension to the metal foil in the apparatus of Figures 1 or 2,

Figure 4 is a diagrammatic representation of one alternative apparatus for applying tension to metal foil,

Figure 5 is a diagrammatic representation of another alternative apparatus for applying tension to metal foil,

Figure 6 is a diagrammatic representation of yet a further alternative apparatus for applying tension to metal foil.

Referring to the drawings, a narrow strip of unplasticized polyvinyl chloride having a fluted upper surface is extruded from die 2 and passes between rollers 3 and 4. The lower pressure roller 4 is driven (by means not shown) and the upper roller is freely rotatable about the axially extending rod 3a and is shaped to conform exactly with the fluting on the surface of the extruded strip and is referred to as the profile roller. Rod 3a is mounted on an adjustable block 7 which can be raised or lowered by screw-threaded adjusters 8 and 9 to vary the gap between the rollers and hence the pressure applied between the foil and extruded strips. Springs 5 urge the upper roller away from the lower roller to maintain the gap between the rollers in the absence of material passing therethrough.

A metal foil 10 is taken from a supply roll thereof, tensioned by the method described below with reference to Figure 3, and passed under guide-bar 11, which has its axis parallel to the axis of profile roller 3, to ensure that it is applied to the strip exactly parallel to the direction of movement thereof. The foil then passes over and round profile roller 3 and is pressed into contact with the polyvinyl chloride strip material by the nip formed between rollers 3 and 4. The metallized strip is then drawn away over guide-plate 13 and quenched or subjected to a further shaping operation as required.

In Figure 2 is illustrated a further shaping operation in which the metallized strip, before quenching, is passed to a forming jig 14 contained in a vessel 15. On entering the vessel 15, the strip passes over a semi-circular mandrel 16 and between sideformers 17 which convert the flat strip into a strip having a generally C-shaped cross-section. Whilst held by the mandrel and side-formers, the strip is quenched by the application of cold water supplied by taps 18. The resultant product may then cut into required lengths as it passes out of vessel 15.

Convenient methods for applying tension to the foil are described with reference to Figures 3, 4, 5 and 6 of the drawings.

Referring to Figure 3, the metal foil 10 is contained on a hollow spool 50 which is a press fit onto a support 51 having at one end a flange 52 and which is free to rotate about stud 53. The support 51 has a slight taper from the flange 52 to ensure that the spool 50 fits sufficiently tightly onto the said support to prevent rotation of the spool about the support when the foil 10 is under tension. The stud 53 is mounted on a bracket 55 and has an end 54 screw-threaded to take a tensioning nut 56 and a locking nut 57, which nuts are turned by arms 58 and 59 respectively. A fibre friction pad 60 is placed between the flange 52 of the support 51 and the supporting bracket 55 and a second fibre friction pad 61, having a bronze back-up washer 62, placed between the support 51 and the tensioning nut 56.

The tension in the foil 10 when taken from the roll is controlled by the frictional drag exerted by the friction pads 60 and 61 on the support 51. It can be seen that the tighter the tensioning nut 56 the greater the frictional drag applied to the support 51, and hence the greater the tension in the foil 10. Tensioning nut 56 is tightened such that the tension in the foil is sufficient to avoid cockling when the said foil is applied to the thermoplastic extrudate.

An alternative convenient method of tensioning the foil employs a pressure roll above and in contact with the profile roller 3 as shown in Figure 4. Thus the foil 10 is passed around the guide-plate 11 and between the nip formed by the freely rotatable pressure roll 20, mounted on an axle 21, and the profile roll 3 and is then applied to the extrudate 1 as previously described. The pressure exerted by the pressure 20 may conveniently be controlled by an adjustable spring loaded device (not shown) bearing on the roll axle 21.

The tensioning apparatus of Figure 5 comprises a disc member 30 mounted on the back of the roll from which the foil 10 is drawn, a

caliper brake 31 and a tension gauge generally indicated by 32 and comprising a dial 32, an indicating finger 33 mounted on an elongated member 34, which is free to move about pivot 35 and which has a foil guide 36 mounted on the end of the said member remote from the pivot 35 and indicating finger 33. The foil 10 is drawn from the roll passed under guide 36 and thence passes to guide 11 of Figures 1 and 2. Tension is applied to the foil by application of the caliper brake 31 which applies a resistance to rotation of disc 30. An increase or decrease in tension of the foil causes the member 34 to pivot about point 35 and change the reading on dial 32. A constant reading on dial 32 indicates constant foil tension.

The method of tensioning the foil using the apparatus of Figure 6 comprises passing the foil between freely rotatable nip rolls 40 and 43. Roll 40 is mounted on a swing arm 41 which is itself pivotally mounted on a frame member 42. Roll 43 is mounted on frame 42 and the frame together with the rolls is free to pivot about frame mounting 47. A change in tension of foil 10 between the nip rolls 40 and 43 and the profile roller 3 and associated pressure roller 4 will cause the frame to pivot about frame mounting 47. The indicator finger 45 and dial 46 give a visual indication of the degree of pivoting which has taken place. The pressure exerted by roll 40 on roll 43 which controls the tension in the foil, can be adjusted by the spring-loaded pressure device 44 which is also mounted on the frame 42. Constant foil tension is again indicated by a constant dial reading.

Using the process and apparatus as described above with reference to Figures 1 and 3, unplasticized polyvinyl chloride is extruded through die 2 at a temperature of 165° to 170° centigrade to produce a strip having a fluted upper surface as shown in the drawings. The strip has an end width of 3.0 inch and an upper surface width of 3.4 inch and a thickness of about 1 mm at the base of the flutes. The extrudate is passed between a pair of rubber rollers placed 4 inches from the die, the upper of which rollers is shaped to conform exactly with the fluted upper surface of the extrudate, the lower roller is driven at a speed of 10 feet per minute (that is the rate of production of extrudate). Aluminium foil, 2.87 inches wide and 12 microns thick, having on its upper surface a gold-coloured polyester finish and on its lower surface an adhesive, is taken from the roll thereof, tensioned by the method described with reference to Figure 3, passed under the guide bar 11 and over the upper roller 3 such that the adhesive covered surface contacts the extrudate as the foil and extrudate pass between the nip formed by roller 3 and 4. The aluminium foil strip employed is supplied by Chamberlains of North End, Higham Ferrers, Northants., and has an adhesive backing.

The temperature of the polyvinyl chloride extrudate at the time at which it passes between the rollers is in the order of 140° to 160°C and the pressure applied is 100 lbs per square inch gauge. Under this pressure the aluminium foil stretches to cover the surface of the polyvinyl chloride extrudate except for 0.04 inches on one side of the strip and 0.08 inches on the other side. The gold-coloured aluminized polyvinyl chloride strip is then passed to the forming jig 14 where it is shaped into a curtain rail trim having a C-shaped cross-section and quenched as previously described. As it leaves the jig, it is cut into convenient lengths for use as a curtain rail trim.

The thermoplastic extrudate will generally have a minimum thickness of not less than about 0.25 mm and preferably not less than 0.5 mm.

The rollers 3 and 4 need not be rubber and may be of any other suitable material provided that one roller has a rigid surface to support the extrudate, and the other roller is sufficiently pliable to allow the extrude to vary its dimensions slightly and to "mould" its profile to suit such variations.

The product has improved surface definition and a reduced tendency to delaminate compared with that produced by an alternative process, in which the fluted polyvinyl chloride strip is re-heated and the gold-coloured aluminium foil then applied under pressure and that the strip then shaped into the C-shaped cross-sectional form required. The product produced by the process and apparatus of the present invention also has an improved surface appearance almost indistinguishable from that obtained by vacuum deposition. Also the fact that the foil stretches during application by up to 17% means that less foil is employed.

WHAT WE CLAIM IS:—

1. A method of applying a metal foil to the surface of a polyvinyl chloride sheet or strip material comprising extruding the polyvinyl chloride through a die into sheet or strip form having a thickness of at least 0.25 mm, immediately applying the metal foil directly thereto under pressure at ambient temperature and while the polyvinyl chloride is in a plastic condition and subsequently quenching the foil-polyvinyl chloride laminate.

2. A method according to claim 1 wherein the pressure applied to the foil is about 100 lbs. per square inch gauge.

3. A method according to claim 1 or 2 wherein the metal foil has an adhesive backing.

4. A method according to any one of the preceding claims wherein the pressure is applied by passing the foil and extruded strip through the nip formed by a pair of rollers one of which is a driven roller.

5. A method according to any one of the preceding claims wherein the surface of the polyvinyl chloride sheet to which the foil is to be applied is fluted.

6. A method according to claims 4 or 5

wherein the non-driver roller is shaped to conform with the fluting on the polyvinyl chloride sheet.

7. A method according to any one of the preceding claims wherein the metal foil and polyvinyl chloride laminate is subjected to further shaping before quenching.

8. A method according to any one of claims 2 to 7 wherein the metal foil is tensioned by controlling the rate of withdrawal thereof from the said supply.

9. A method according to claim 8 wherein the rate of withdrawal is controlled by passing the foil through a pair of freely rotatable nip rolls the pressure between which is capable of adjustment.

10. A method according to claim 9 wherein one of the freely rotatable rolls is the non-driven roller of the pair of rollers which form a nip to apply pressure to the foil as claimed in claim 4.

11. A method according to claim 8 wherein the supply of metal foil is in the form of a roll thereof supported on a shaft and the rate of withdrawal is controlled by braking means applied to the shaft.

12. A method according to claim 11 wherein the braking means comprises a disc member located adjacent the roll of foil and on the same shaft and a caliper brake arranged to control the rate of rotation of said disc.

13. A method according to claim 8 wherein the supply of metal foil is in the form of a roll on a cylindrical spool said spool being mounted on a cylindrical rotatable support having front and rear ends the rate of withdrawal of the foil from the roll being controlled by frictional braking means applied to the said ends of the rotatable support.

14. A method according to claim 13 wherein the frictional braking means comprises fibre friction pads compressed against the front and rear ends of the said support to restrain the rotation thereof.

15. A method according to any one of the preceding claims wherein the metal foil is aluminium foil and the temperature of the polyvinyl chloride at the point of application of the aluminium foil is in the range of 140° to 160° C.

16. A method according to claim 15 wherein the polyvinyl chloride-aluminium foil laminate is subjected to further shaping before quenching.

17. Apparatus when used in carrying out the process of claim 1 comprising a die through which the polyvinyl chloride is extruded; a pair of nip rolls, one of which is a driven roll, adjacent said die and aligned to receive the extruded strip; means for supplying metal foil to the said nip rolls and including brake means co-operating therewith to apply tension to the metal foil prior to it reaching the said nip rolls; a guide bar to direct the foil between the said nip rolls, and means for quenching the extruded and laminated polyvinyl chloride sheet.

18. Apparatus according to claim 17 wherein the supplying means comprises a rotatable support for a roll of metal foil and the brake means comprises a pad pressing onto the support.

19. Apparatus according to claim 17 wherein the supplying means comprises a shaft for supporting a roll of metal foil and the brake means comprises a disc member mounted adjacent the roll of foil and on the same shaft and a caliper brake arranged to control the rate of rotation of said disc.

20. Apparatus when used in carrying out the process of claim 1 comprising a die through which the polyvinyl chloride is extruded; a first pair of nip rolls, one of which is a driven roll, adjacent said die and aligned to receive the extruded strip; means for supplying metal foil to the said first nip rolls; a second pair of nip rolls, each of which is freely rotatable, located between the foil supplying means and the first nip rolls to control the rate of withdrawal of the foil from the supply thereof, one of said nip rolls being adjustable to vary the pressure therebetween; a guide bar to direct the foil between the said nip rolls, and means for quenching the extruded and laminated polyvinyl chloride sheet.

21. Apparatus according to claim 20 wherein one of the second said nip rolls is the non-driven roll of the said first nip rolls.

22. Apparatus according to any one of claims 17 to 21 including means for further shaping the extruded, laminated strip, which means includes a semi-circular mandrel and side formers to form the flat strip into a C-shaped strip, between which the said strip is introduced prior to quenching.

23. Apparatus according to any one of claims 17 to 22 wherein one of the nip rolls is freely rotatable and is shaped to conform with the surface of the extruded strip which it contacts.

24. A method according to claim 1 substantially as herein described.

25. Apparatus according to claim 17 substantially as herein described with reference to Figures 1 and 2 taken together with Figures 3 and 4 of the drawings.

26. Apparatus according to claim 22 substantially as herein described with reference to Figures 1 and 2 taken together with Figures 4 and 6 of the drawings.

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1533658 COMPLETE SPECIFICATION
4 SHEETS *This drawing is a reproduction of the Original on a reduced scale*
Sheet 1

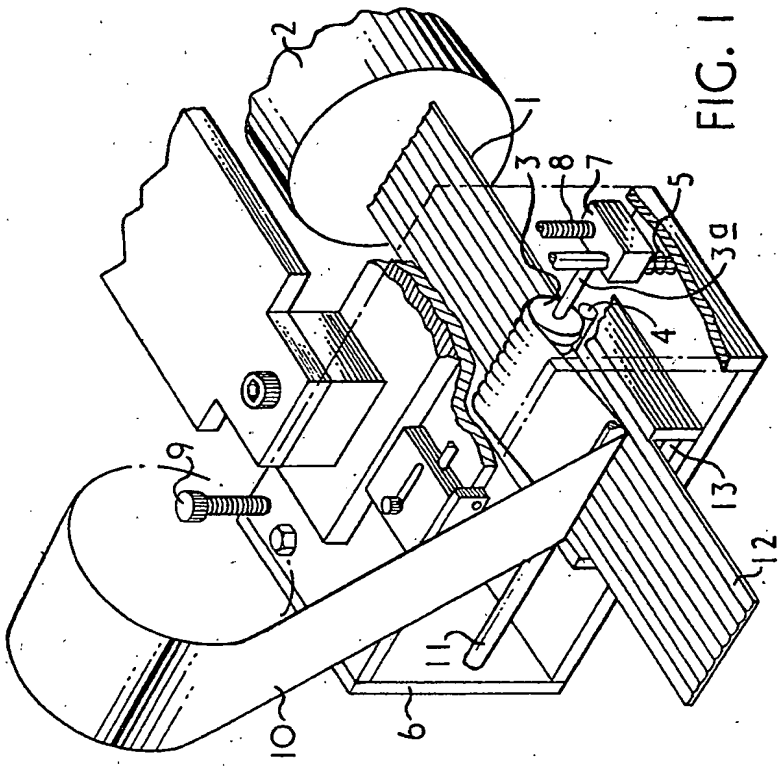

FIG. 1

1533658 COMPLETE SPECIFICATION
4 SHEETS *This drawing is a reproduction of the Original on a reduced scale*
Sheet 2

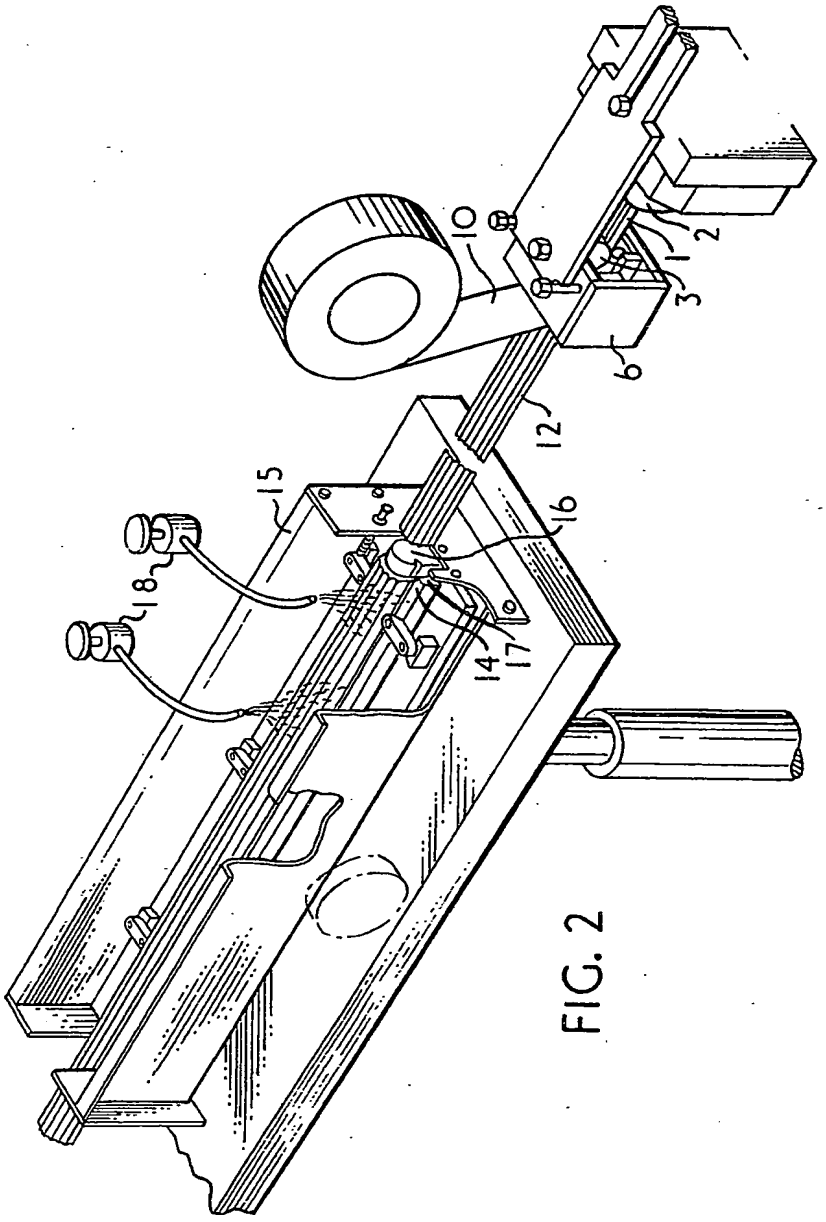

FIG. 2

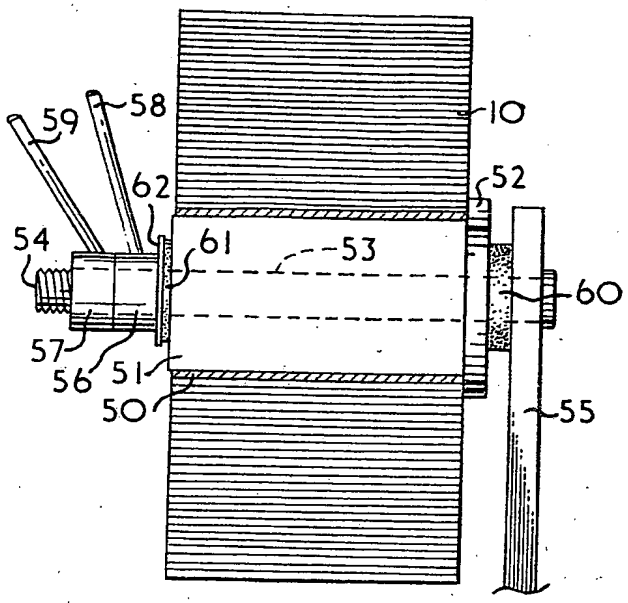

FIG. 3

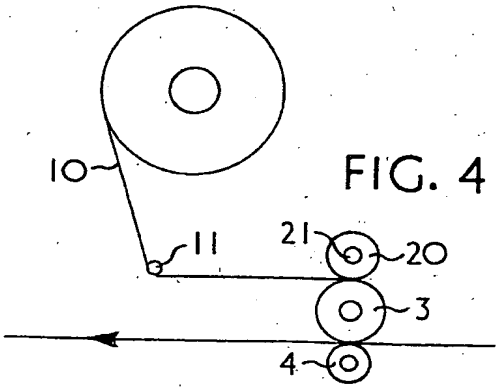

FIG. 4

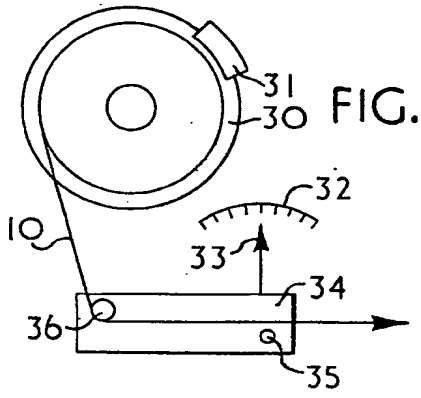

FIG. 5

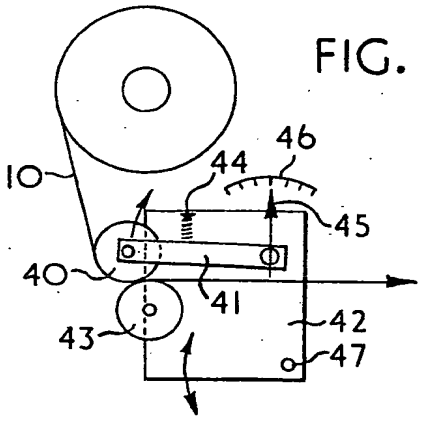

FIG. 6

METHOD AND APPARATUS FOR THE METALIZATION OF THERMOPLASTIC MATERIALS

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Applicant: SWISH PROD
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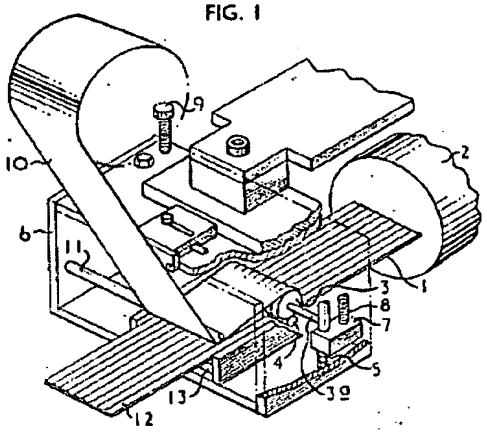
- european: B29C47/00; B32B15/08
Application number: GB19740054838 19751218
Priority number(s): GB19740054838 19751218

Abstract of **GB1533658**

1533658 Laminating metal foil to plastics extrudates SWISH PRODUCTS Ltd 18 Dec 1975 [19 Dec 1974] 54838/74 Heading B5N A metal foil 10 is applied under pressure at ambient temperature to the surface of a sheet or strip 1 of polyvinyl chloride of thickness at least 0A25 mn. immediately after extrusion of the latter from a die 2, and the resultant lamin- ate is subsequently quenched. As shown, the foil 10 is guided by a bar 11 and is pressed on to the extrudate by non-driven and driven rollers 3, 4 whose nip is adjustable, roller 3 having a fluted surface which corresponds with a fluted surface pattern on sheet 1. The laminate may be further shaped by a semicircular mandrel and side formers to produce a C-shaped curtain rail and quenched by cold water taps. In an example an unplasticized p.v.c. strip is ex- truded at 165-170 C. and pressed whilst at 140-160 C. on to an adhesive-backed alu- minium foil having a decorative polyester finish. The foil 10 may be supplied under tension to the rollers 3, 4; in exemplified constructions (Figs. 3-6, not shown), (i) the foil passes between freely-rotating pressure rollers, one of which is spring-loaded and the other of which may be roller 3, (ii) friction pads exert a drag on the support for a roll of foil, under the influence of a tensioning nut, and (iii) a caliper brake acts on a disc rotating with a shaft which supports a roll of foil.

FIG. 1



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Family list
1 family member for:
GB1533658
Derived from 1 application.

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